

THE BOREAL FOREST — TEACHING GUIDE

About the Book

Combining lyrical storytelling with expertly researched informational text, this beautiful book provides a year-long tour of the planet's largest land biome — one of our most important wildernesses.

The vast boreal forest spans a dozen countries in the northern regions like “a scarf around the neck of the world,” making it the planet's largest land biome. Besides providing homes for a diversity of species, this spectacular forest is also vitally important to the planet: its trees clean our air, its wetlands clean our water and its existence plays an important role in slowing global climate change. In this beautifully written book, award-winning author L. E. Carmichael explores this special wilderness on a tour of the forest throughout the four seasons, from one country to another. Evocative watercolor and collage artwork by award-winning illustrator Josée Bisailon provides a rare glimpse of one of the world's most magnificent places.

With excellent STEM applications in earth science and life science, this enjoyable book aims to foster environmental awareness of and appreciation for this crucial forest and its interconnections with the entire planet. In a unique approach, the text features a lyrical fictional narrative describing the wildlife in a specific part of the forest, paired with informational sidebars to provide further understanding and context. Also included are a world map of the forest, infographics on the water cycle and the carbon cycle, a glossary, resources for further reading, author's sources and an index. This book has been reviewed by experts and was written in consultation with Indigenous peoples who live in the boreal forest region.

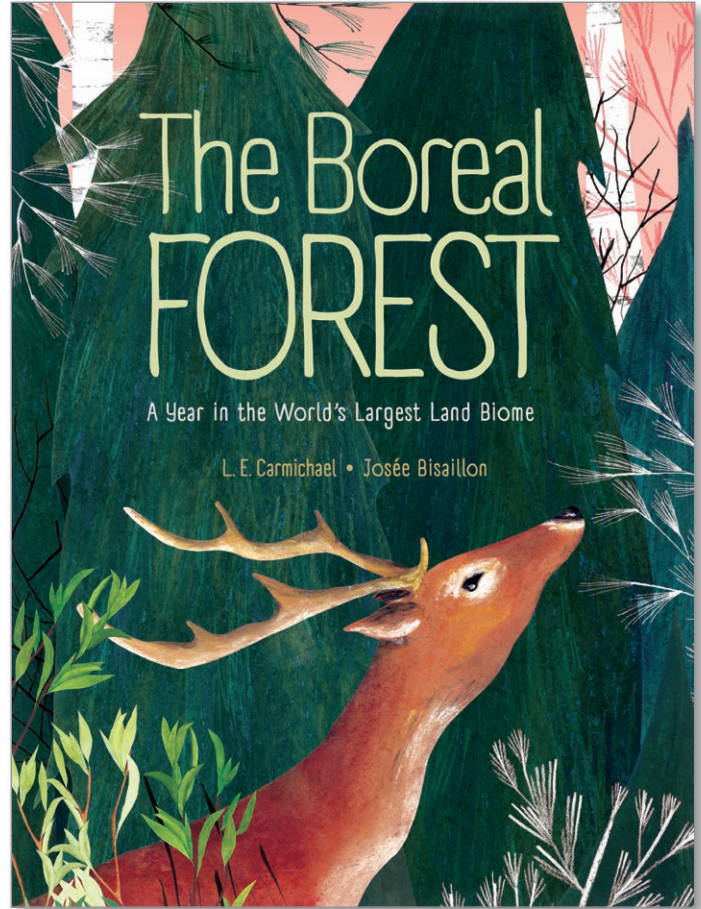
About the Author

At some point, every kid starts asking, “Why?” Lindsey Carmichael never stopped. As a PhD candidate, she uncovered new reasons why arctic foxes are the coolest; as a forensic scientist, she found out why bears sometimes get away with murder. As a writer, she follows her sense of wonder to the “whys” of subjects as diverse as nature, the environment, medicine and technology.

The award-winning author of more than 20 STEM books for children and young adults, Lindsey writes to spark her readers' curiosity and ignite their imaginations. Packed with “oh wow!” and “I never knew that!” her books reveal the process of discovery and the stories behind the science.

Publishing under the name **L. E. CARMICHAEL**, Lindsey loves beaches, platypuses, and all things fantasy. She's fascinated by the moment when facts reveal truth.

Lindsey lives in Ontario with her husband and a six-toed cat named Sasquatch.



ISBN 978-1-5253-0044-8

About the Illustrator

As a young girl, **JOSÉE BISAILLON** loved drawing cats and houses. She really enjoyed school and always returned home full of stories to tell (and, of course, to draw!). She liked being in the classroom so much that she pursued her education all the way to university, where she studied graphic design. It was there that she fell in love with illustration.

Since that time, with scissors and brushes in hand, Josée has illustrated more than 30 picture books. She also illustrates for magazines and newspapers.

Josée lives just outside of Montreal with her family, their hairless cat, and many characters she created.



We acknowledge the assistance of the Ontario Creates Book Fund, an initiative of Ontario Creates.

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About this Resource

Every page of *The Boreal Forest: A Year in the World's Largest Land Biome* does two things: tells a story and provides factual information. This resource will split those pieces up so that students can work to understand first the story of the forest, and then the factual sidebars. For older students, you may assign the reading as homework — but encourage them to read the book twice, as you will do through the following guided exercises. Understanding the story will help students comprehend the scientific material in the sidebars when they get to it, but trying to read both at once can sow confusion and cause students to disengage.



Overview

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Whole Group

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Small Groups

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Small Groups

Activity Four: The Carbon Cycle

Whole Group

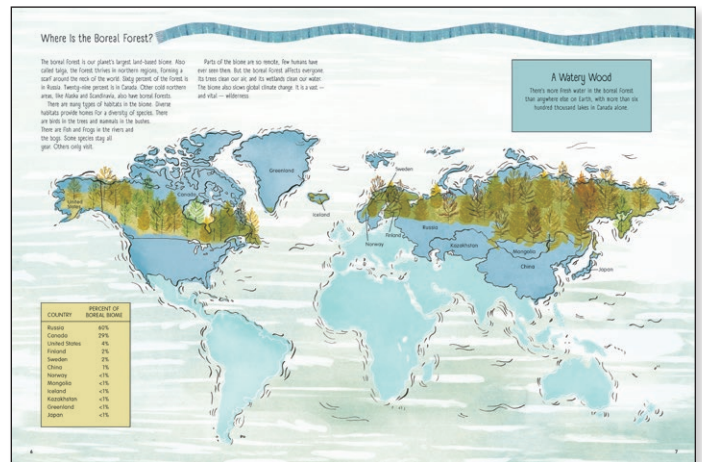
Bonus Individual Activity: World Map of the Forest

Independent Work

Activity 1: Reading for Story

Whole Group

Prepare for this lesson by hanging a map of the world in front of the room and placing a box of about 15 thumbtacks (or very small circular stickers) nearby. Also write the four seasons on the board in a circle, as below. Leave room to draw arrows from one season to the next, but don't add the arrows yet.



Read aloud from the top of **page 5** through to the end of **page 6**, holding up the page of the book featuring a map of the world and pointing out the map you've placed on the board or wall. Disregard the text boxes with facts and figures.

Starting with **page 8**, choral read only the main text — explain that you will only ignore the text boxes for this first read-through of the book, but that each one contains important information to which you will return. For now, the idea is to focus on — and understand — the story.

After reading page 8 aloud, have a student place a pin on Russia on the world map. Ask another to underline the word *Winter* on the board.

As a group, discuss the sensory language used on page 8.

- “creaks and cracks”: sense of sound
- “gray sky” and the description of the squirrel: sense of sight
- Ask: What rustles in the snowy boughs? [Tiny ice crystals] What made them? [Squirrel’s breath]
- What does it mean for snow to “blanket” the trees? [It covers them entirely; this is a metaphor]
- Turn to the glossary to learn what a “catkin” is. [A cluster of flowers that forms a long stalk.]
- What makes the sound “*whoomp*”? [Snow falling after the squirrel leaps toward the catkin, which she will eat.]

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Engage in a discussion about the contents of this page. Some questions may include:

- What have you learned about the forest so far?
- What animals live there and what do they eat?
- What plants live there?

Turning to **pages 10-11**, ask a student to put another pin on Finland on your world map. Underline *Winter* on the board again. Now choral read the two paragraphs on page 11, and engage students in a discussion of what they learn here. Questions can include:

- What might grow on the bush in the spring and summer?
- Why is the beetle under the snow?
- Why is the shrew under the snow?
- What happens to the beetle?

Continue with this format for the remainder of the book, reading only the text that tells the story of the forest.

Continue to add pins in the world map (countries are indicated in a little flag in the top corner of each spread) and underline the season being discussed. The following notes can guide your discussion, but feel free to add your own.

Pages 12-13

- Mark Norway on the map
- Underline *Winter* again
- Discuss the picture of the owl. How do students feel about it?
- What is she doing? [hunting a vole]
- What are the reindeer doing? [eating lichen]

Pages 14-15

- Mark Canada on the map
- Underline *Winter* again
- How do you know the lake is frozen?
- How do you think fish can survive in the frozen lake? [Don't read the text box about this; let students make predictions and come back to this idea later]
- Is the mole a fish or a mammal?
- What are some examples of figurative language from this page? [“*Slurp!*”]

Pages 16-17

- Mark Mongolia on the map
- Underline *Spring* and now draw an arrow from Winter pointing to Spring
- Underline the words “fir” and “sable” in the first paragraph and use context clues and the picture to figure out what these words mean
- “The tree breathes in” is an example of personification. Discuss with the group if, in this case, the author intends that, or if she means it literally.
- Why is the last line of the page hopeful?

Pages 18-19

- Mark Japan on the map
- Underline *Spring* again
- Review sensory language
- If you have access to the internet, ask students to look up “raccoon dog.” Is this an animal they might see close to home?

Pages 20-21

- Mark China on the map
- Underline *Spring* again
- Ask the students reading this page aloud to try to evoke the actions described with their tone of voice

Pages 22-23

- Mark Russia on the map for a second time
- Underline *Spring* again
- Tell students that a loon is an aquatic bird similar to a duck. Where might the loon be hiding in this scene? Can students practice making the loon's yodel?

Pages 24-29

- Mark Canada on the map for a second time
- Underline *Summer* and draw an arrow from *Spring* to *Summer*
- Can students point to details in the text and the illustration that show a storm is coming?
- On the second spread, the storm has arrived. Why is now a time for the hawk to be out hunting?
- On the third spread, why does the fox wrinkle his nose? What smells bad?

Pages 30-31

- Mark Russia on the map for a third time
- Underline *Summer* again
- Use context clues (and the internet) to figure out what a “bladderwort” is [Carnivorous plant!]

Pages 32-33

- Mark Canada on the map for a third time
- Underline *Autumn* and draw an arrow from *Summer* to *Autumn*
- Use context clues to define words like “fen” and “kits”

Pages 34-35

- Mark Russia on the map again
- Underline *Autumn* again
- Repeat this line aloud: “Hoarfrost formed in the night — every tree and twig is dressed in diamonds.” Ask students to predict what's coming. If students need a hint, review page 11 for the first use of “hoar” to describe a type of ice.
- What does the last line of this page predict?

Pages 36-37

- Mark Russia on the map again
- Before the final paragraph is read aloud, ask students how they know winter is coming.
- Draw a faint arrow from *Autumn* to *Winter*, almost completing the circle.

Pages 38-39

- Mark the United States on the map
- Underline *Winter* again
- Ask students to talk about how this page reminds them of the beginning of the book.

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Wrap up your group discussion of the story by asking students what they most remember from their choral read-through. Do they recall the funny sounds some of the animals made, or different ways the author evokes smell or touch or temperature? While this story doesn't have characters in the traditional sense, which of the animals and plants do students best recall without looking back at the pages? Do they think this is a good, or fun, or interesting way to learn about the boreal forest? If so, why?

Activity 2: Scientific Comprehension

Small Groups

Now divide the class into four small groups. Each group will review the informational text boxes for one season: Winter, Spring, Summer, and Autumn. Students will digest and interpret the information in each box before presenting the facts about their season to the class.

Ask students to read the content of each text box within their page ranges. Then, taking turns, each group will present the content of their text boxes to the large group. Encourage students not to simply read from each text box, but to explain the concepts they learned and point out details that are illustrated in the paintings on the page.

If time and resources allow, encourage students to do Internet searches for the key words in some of their text boxes, so that they can learn more about some of the topics and share details with the class that are not in the book.

Winter

Pages 8–15

Summer

Pages 24–31

Spring

Pages 16–23

Autumn

Pages 32–39

Activity 3: Time for Science!

Small Groups

Below are three experiments or exercises that will help your students better understand some of the earth and life science behind the facts in *The Boreal Forest*. Have students work in small groups, assigning each group one or more of these activities. Depending on time and resources, each small group can do one activity, or each group can do all of the activities over several days.

1. ALIVE OR FROZEN?

Review the text box on page 39 about the wood frog. It says this animal freezes solid in winter, but returns to life in the spring. Ask students to watch this 5-minute video about the wood frog to learn more:

<https://www.youtube.com/watch?v=TYJv-wxwvLw>

Now encourage the group to review the characteristics of life and to discuss them in relation to the wood frog and/or any other animals they learned about in *The Boreal Forest* that they would like to research now.

Characteristic of life include:

- being made of cells
- responding to the environment and
- having the ability to:
 - grow or change
 - reproduce
 - metabolize food
 - breathe
 - maintain homeostasis
 - pass traits to offspring

Is the wood frog doing any of these things in the winter? How do we know it is alive, if not?



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2. SOIL AS FILTER

We learned in *The Boreal Forest* that trees clean the air and wetlands clean the water. In this experiment, we'll see that soil can also work as a filter, cleaning the water that passes through it.

Materials:

- 1 large cup with hole poked in the bottom
- 1 smaller cup
- Sand, as for a sandbox
- Topsoil, as found outside
- Kool-Aid mix
- Water

Part One:

1. Mix Kool-Aid powder with water, but do not drink it.
2. Fill the large cup a quarter full with sand.
3. Fit the large cup into the smaller cup, which will catch anything that passes through the sand.
4. Pour a small amount of Kool-Aid through the sand.
5. Wait for it to filter through, and remove the top cup.
6. Record your observations about what happened. What color is the water in the small cup?
7. Pour out and dispose of the liquid. Keep the sand in the cup for part two.

Part Two:

1. Add topsoil to the cup with (now wet) sand until the cup is half full.
2. Fit the large cup inside the small cup as before.
3. Pour a small amount of Kool-Aid through the topsoil/sand.
4. Wait for it to filter through, and remove the top cup.
5. Record your observations about what happened. What color is the water in the small cup? Is it a different color than before? What color is the sand now?
6. Pour out and dispose of the liquid and clean up all the supplies.

What can you conclude about how sand alone cleans water? What can you conclude about how topsoil-covered sand cleans water? What does this reveal about the importance of soil in our ecosystems?



3. THE WATER CYCLE

Review the water cycle diagram on pages 40-41. Ask students to watch this short video about the water cycle to learn more: <https://gpm.nasa.gov/education/videos/water-water-everywhere>

Now have students conduct the below experiments over several days to show how certain parts of the water cycle work.

Part One:

Materials:

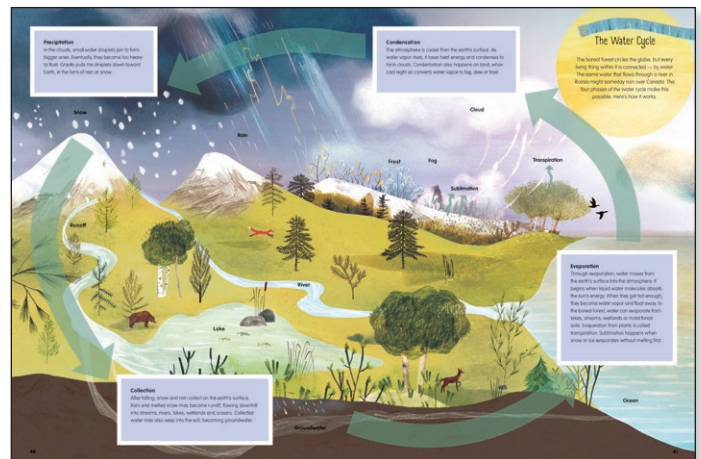
- Houseplant
- Water and watering can
- Large plastic bag
- Rubber bands

Note: You can extend this exercise by having students plant their own seedlings, and conduct the experiment once those plants have grown to be about 6 inches tall.

On day one (determined by the size of the plant: it should be no more than 6 inches tall), water the plant and place the plastic bag over it. Tie the bag tightly but carefully around the base of the plant, making sure not to damage the plant stem. Set the plant in the sun.

On day two or three — depending on how much sun exposure the plant has received, and waiting until there is water visible on the plastic bag — demonstrate to students that the plants took water in through its roots, moved that water through the plant, and then released, or transpired, the water through its pores and stomata.

While you wait for the plant to transpire, conduct this other mini-experiment based on the water cycle.



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Part Two:

Materials:

- A juice or soda can kept cold in the fridge
- A bin filled with water at room temperature
- A dry cloth

Have a student remove the can from the fridge, dry it with the cloth (but do not open the can), and hold it about a foot above the bin of water. Careful not to drop it! Also be careful that the student keeps their fingers on only one spot on the can.

After 10-15 seconds, have students come closer to see what's happening. Is water forming on the can? Yes, and this is called condensation. Where did this water come from? Did anyone see the water in the tub move? Help students understand that the water vapor that condensed on the outside of the can was in the air.

Conduct a similar experiment without the bin of water. Does anything different happen? What might this mean about how much water vapor is in the air all around us?

Activity 4: The Carbon Cycle

Whole Group

Review the carbon cycle on pages 42-43. Explain that the group will now play a game to help make sense of the carbon cycle.

Materials:

- 24 ping-pong balls, to represent carbon
- Markers
- Chalk
- A large, open space, preferably outside on a blacktop

Using the chalk, draw three regions on the blacktop:

- lakes and oceans
- land
- atmosphere

Divide students into 6 groups, assigning each one of the following roles and asking them to move to the appropriate region:

- atmosphere — stands in the atmosphere region
- water — stands in the ocean region
- moss — stands in the land region
- sediments & rocks — stands in the land region
- trees — stands in the land region
- elk — stands in the land region

Give each group 4 ping-pong balls, explaining that they represent carbon atoms.

Give each group one marker and instruct them to write the first letter of their group on their four ping-pong balls. The “atmosphere” group will draw a letter A while the “moss” group will draw a letter M on each of their ping-pong balls and so on.

As everyone is standing in their region, explain that when it is their turn, they can give some of their carbon to another group, but they must always keep at least one carbon atom.

One group goes at a time, giving another group some of their carbon. At first, each group only gives away 2–3 atoms, but over time one or two groups will collect much more. If one group has a lot of carbon, they can distribute it to more than one group — but they must always keep at least one atom.

At each turn, the group has to make a different choice than last time about where they spread their carbon.

Go around the groups until everyone has delivered carbon at least four times. Where has most of the carbon landed?

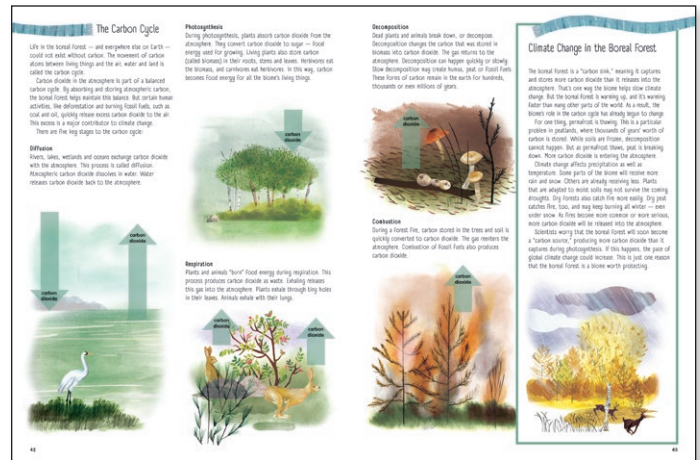
Trace the journeys of the carbon atoms. Ask each group to record how many of the other groups’ atoms they are now holding. Note that none of the carbon has disappeared, only moved around.

Point out to students that this game pretended that carbon can go anywhere, and that humans are not involved in the carbon cycle. Of course, we know that humans influence the carbon cycle with most of their activities, and that most of the carbon controlled by humans ends up in the atmosphere.

Back in the classroom, discuss how the game would have been different if one of the characters was a human:

- extracting and burning fossil fuels for energy? [The carbon would move from the sediments and rocks into the atmosphere.]
- cutting and burning trees to create farmland or to build? [The carbon would move from the land into the atmosphere.]

Point out that while humans have not created more carbon, we do move it into the atmosphere more quickly than would naturally occur, and this has consequences for climate change.



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Bonus Individual Activity: World Map of the Forest *Independent Work*

For students who need a more artistic outlet, or as an additional activity for the whole group, make papier-mâché globes.

Materials:

- Flour
- Water
- Bowl
- Whisk
- Strips of newspaper
- Balloons
- Paints
- A world map as model (such as the one on pages 6-7 of *The Boreal Forest*)

1. Mix one part flour with two parts water, pouring in the water gradually and stirring to remove lumps.
2. Microwave at high for 30-40 seconds. Stir again and return to microwave for 30-40 more seconds. Repeat until the mixture thickens to appear like thick soup.
3. Let cool.
4. Cut newspaper into strips, and soak in the mixture.
5. Blow up a balloon and apply newspaper strips with flour-water mixture until the balloon is completely covered in one layer of papier-mâché. Let dry and repeat.
6. When the balloon is totally covered and the newspaper is completely dry, paint the entire thing blue.
7. When the blue paint dries, paint in the continents using green paint.
8. When the green paint dries, add the boreal forest “like a scarf around the neck of the world” using light brown and white paints.

Display the globes around the classroom.

